A Generative Machine Learning-Based Approach for Inverse Design of Multilayer Metasurfaces

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Abstract

The synthesis of a metasurface exhibiting a specific set of desired scattering properties is a time-consuming and resource-demanding process, which conventionally relies on many cycles of full-wave simulations. It requires an experienced designer to choose the number of metallic layers, the scatterer shapes and dimensions, and the type and the thickness of the separating substrates. In this article, we propose a generative machine learning (ML)-based approach to solve this one-to-many mapping and automate the inverse design of dual- and triple-layer metasurfaces. Using this approach, it is possible to solve optimization problems with single or more constraints by synthesizing thin structures composed of potentially brand-new scatterer designs, in cases where the interlayer coupling between the layers is nonnegligible and synthesis by traditional methods becomes cumbersome. Various examples to provide specific magnitude and phase responses of <inline-formula> <tex-math notation="LaTeX">x </tex-math></inline-formula>- and <inline-formula> <tex-math notation="LaTeX">y </tex-math></inline-formula>-polarized scattering coefficients across a frequency range as well as bounded responses for different metasurface applications are presented to verify the practicality of the proposed method.